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(57)Abstract:
PURPOSE: To intensity the sticking power to the biobone tissue by sticking coarse particles of specific grain sizes to the surface of a base material layer in the state of sticking to each other via an adhesive layer formed by melting a part or the whole of the fine particles.
CONSTITUTION: The coarse particles consisting of sponge titanium sized 100 to 400μm are stuck to the surface of the implant base material made of a titanium alloy. The fine particles of the titanium are partly or completely melted by plasma and are utilized as an adhesive for sticking the fine particles at this time. Then, pores having about 150 to 350μm sizes are formed at a high ratio on the rugged films formed on the surface of the base material. The infiltration and sticking of the biotissue are eventually surely executed and the easy dislodgment of the films by external force is prevented.

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[Example] A plasma gun equipped with two powder ports was provided. A sponge titanium coarse powder having a mean diameter of 350 micrometers was discharged from one port, and a fine powder having a particle size of 44 micrometers from other ports. A plasma metal spray was performed by turns from each port towards the implant base material made from a titanium alloy. As a result, a concavo-convex film having a pore diameter of 150 to 350 micrometers was formed on the base material front face. In order to set thickness of this film to about 1mm, What is necessary is just to repeat mutual thermal spraying of the above-mentioned fine and coarse powders 2 to 8 times.

[0014] Fig.1 is a graph which shows the relation of the thermal-spraying ratio and the porosity. When the thermal-spraying ratio of the fine powder is low, it turns out that the porosity becomes high.

[0015] Moreover, Fig.2 is a graph which shows the relation of the thermal-spraying ratio of the fine powder and the particle bonding strength. An inverse proportion relation between the ratio of a particle and the bonding strength is made. The higher the thermal-spraying ratio becomes, the stronger the bonding strength becomes and the lower the possibility of omission of the film becomes .

[0016] In order to acquire both high porosity and powerful bonding strength, setting the thermal-spraying ratio of the fine powder to 5-50% is recommended as shown clearly from these graphs.

[0017]

[0018]

[0019] (Example of an experiment) According to the following spray condition, Two kinds of powders were thermal-sprayed on a base material at the same time to form a concavo-convex film. After that, the friction test of the concavo-convex film was performed according to an erosion blasting method by JIS H8664-4.6. The result is shown in Figs.4 and 5.

[0020] [Spray condition]

Current: -- 700A

Voltage: -- 64V

Spray distance: -- 300-350mm

Plasma gas: -- Ar= 251L/min, and He=9.5L/min

Ambient atmosphere: -- Ar Pressure =60 mb

Base material: -- Ti-6aluminum-4V ELI or Ti-6aluminum-2Nb-1Ta

Fine powder: -- pure titanium powder (ten to 44 micrometer)

Coarse Powder: Titanium sponge (100 to 400 micrometer)
Conditions for carrying out the simultaneous thermal spraying: Volume ratio of fine powder and coarse powder = 2:8 (Fig.5)
Base material: Ti-6aluminum-4V
Conditions for carrying out the simultaneous thermal spraying: Volume ratio of fine powder and coarse powder = 2:8 (Fig.4)
Base material: Ti-6aluminum-2Nb-1Zr